Methods of Detection and Quantitation of Acrylamide in Cooked Food Products

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Yum! Brands Submission for CIC Public Hearing

September 24, 2003

Sacramento, CA

Personal Background

- Ph.D. (1974), Agricultural Chemistry, UC Davis (Thesis: Formation of Pyrazines in Sugar-Amino Acid Browning Model Systems)
- Professor, Department of Environmental Toxicology, UC Davis, since 1979
- Research: Chemical and Biological Studies on Browning Reaction (Anti-oxidant, anti-mutagen, anti-carcinogen, volatile chemicals)
- Over 230 publications on articles associated with browning reactions out of over 290 publications

Methods of Detection: General Considerations

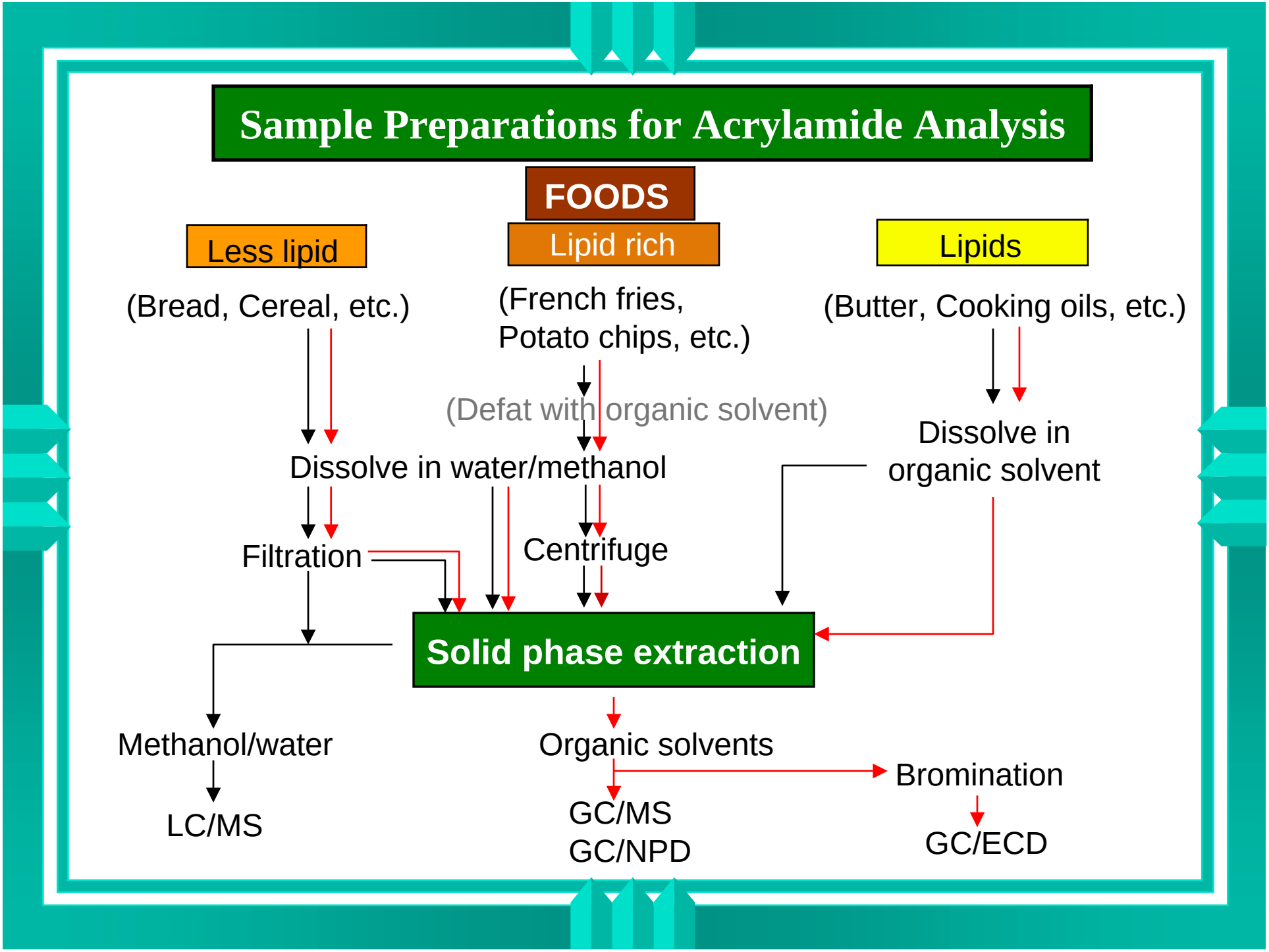
- Three different instruments are available for acrylamide analysis (GC/MS, LC/MS, GC/Nitrogen-Phosphorous Detector (NPD) or Electron Capture Detector (ECD) .
- LC/MS is most the widely used but is too expensive for most individual laboratories to own.
- Cost of performing the tests depends on the laboratory.
- The Limit of Detection depends on nature and chemical complexity of samples (e.g., solid food samples such as bread vs. liquid samples such as coffee).
- LC/MS has an advantage over GC/MS or GC.
  - LC/MS can analyze aqueous samples, while the other methods require the use of organic solvents. (Acrylamide is highly water soluble but less soluble in organic solvents).
- Limit of Quantitation is more important than Limit of Detection in selecting an appropriate test method for acrylamide.
- Adequate preparation of the sample is critical for accurate detection and quantitation. Variations in sample preparation quality may require general reliance on the higher Limit of Quantitation.

Comparison of Analytical Methods for Acrylamide

	Gas Chromatograph/ Mass Spectrometer (GC/MS)	Liquid Chromatograph/ Mass Spectrometer (LC/MS)	Gas Chromatograph/ NP or EC Detectors
Cost of Instrument	$ 50,000 ~ $ 70,000	$ 200,000 ~ $ 300,000	$ 20,000 ~ $ 30,000
Operation	Helium gas	Water/Organic solvents	Helium gas
Sample Preparation	Tedious	Relatively easy	Tedious
Limit of Detection	1 μg/kg~15 μg/kg	1 μg/kg~15 μg/kg	0.5 μg/kg~15 μg/kg
Limit of Quantitation	5 μg/kg~50 μg/kg	5 μg/kg~30 μg/kg	1 μg/kg~50 μg/kg

Cost of Analysis: **1 sample = roughly $100 ~ $1,000, depending on the laboratory**

- Limits of Detection and Quantitation depend on the sample preparation


Sample Preparations for Acrylamide Analysis
FOODS
Less lipid
Lipid rich
Lipids
(Bread, Cereal, etc.)
(French fries,
Potato chips, etc.)
(Butter, Cooking oils, etc.)
(Defat with organic solvent)
Dissolve in water/methanol
Dissolve in
organic solvent
Filtration
Centrifuge
Solid phase extraction
Methanol/water
LC/MS
Organic solvents
GC/MS
GC/NPD
Bromination
GC/ECD